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# Cognitive Remediation Training in Schizophrenia: A Randomized Controlled Trial

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Cognitive impairment is a core symptom in schizophrenia that has a significant impact on psychosocial function, but shows a weak response to pharmacological treatment. Consequently, a variety of non pharmacological interventions have tried to find out suitable out come in patients with schizophrenia. **Objective:** There is considerable interest in cognitive remediation for schizophrenia. Our study aimed to evaluate, in the patients with schizophrenia, the interest of a cognitive remediation program on cognitive performances of patients as well as in clinical and functional outcome. **Method:** Twenty patients with remitted schizophrenia were randomly assigned to 30 days, 70 to 90 minutes individual sessions of cognitive remediation (n=39) or a control condition (n=10). Remediation was performed using brain wave R module. Three procedures were chosen to train four three functions involved, attention/concentration, working memory, logic, and executive functions. Primary outcomes were remediation exercise metrics, neuropsychological composites (episodic memory, working memory, attention, executive functioning, and processing speed), clinical and community functioning measures. **Results:** Cognitive performances concerning Attention/vigilance, verbal working memory and verbal learning memory and reasoning/problem solving improved significantly. **Conclusions:** Cognitive remediation for people with schizophrenia was effective in improving performance, but the benefits of training did not generalize to functional outcome measures. Long term follow-up studies are needed to confirm the maintenance of such improvements.

**Key words:** Schizophrenia, Cognitive Remediation Training, Attention, Memory and Executive function.

## Introduction

Schizophrenia patients frequently exhibit cognitive abnormalities, with an average degree that is one standard deviation below the normative mean [1]. The most severely

compromised areas include working memory, attention, problem solving, processing speed, and social cognition [2]. Compared to positive or negative symptoms, cognitive deficits are a better predictor of long-term functional outcomes, such as independent living and employment performance[3]. When it comes to cognitive deficiencies, both traditional and even second-generation antipsychotic drugs are ineffective[4]. Acetyl-cholinesterase inhibitors are among the pharmacological therapies that have been tested to improve cognition[5].

Interest in a class of behavioral therapies known as cognitive remediation therapy (CRT), which focuses on memory, attention, reasoning, and related skills with the ultimate goal of improving daily functioning, has grown as a result of the discovery that pharmacological intervention has limited efficacy. CRT has already shown promise in the rehabilitation of patients with neurological impairments [6]. Over the past fifteen years, several strategies for improving cognition in people with schizophrenia have been discovered. According to a meta-analysis[7], cognitive remediation for schizophrenia improves cognitive functioning to a moderate degree, and these neurocognitive gains lead to improvements in psychosocial functioning. Additionally, patients accept the intervention well[8] and the effects last for up to six months after the therapy is stopped [9]and the patients embrace the intervention[8]. Nevertheless, the remediation programs employed are highly diverse and there are still few big randomized controlled trials, and the majority of researches have poor methodological quality.

CRT programs vary in assistance (computer or paper and pencil), methods (restorative versus compensatory, "bottom-up" or "top-down" tactics), and quantity of sessions, individual or group work, a customized program tailored to a specific neuropsychological profile, or a standardized program, either in conjunction with or apart from other rehabilitation programs.

Due to the scarcity and variability of studies, the question of which parameters are most effective is still largely unanswered.In their meta-analysis, found that computer-assisted remediation typically has larger effect sizes than paper-and-pencil methods[10]. Good response appears to be predicted by treatment intensity, the patient's prior work habits, the clinician's experience, and the patient's intrinsic drive [11]. We created a broadly focused computer-assisted cognitive remediation program for a sizable number of schizophrenia patients in light of these findings. We postulated that cognitive remediation would enhance patients' performance on cognitive abilities in comparison to a condition intended to account for non-specific treatment effects.

## Methods

The data were collected from inpatient department of Institute of Mental health and Hospital, Agra. In controlled study, we compared a paper pencil cognitive

remediation training strategy added to the standard treatment versus the standard treatment alone(waiting list). Twenty patients were randomized to either the active group (CRT patients, standard treatment and cognitive remediation program, n=10) or to the control group (non-CRT patients, standard treatment only, n=10). The CRT intervention took place over five weeks during the interval. Clinical and cognitive assessments were completed at baseline and after treatment.

**Inclusion Criteria**

- Patients with schizophrenia diagnosed according to ICD-10 criteria.
- Age range between 20-45 years.
- Patients having minimum education up to 5$^{th}$ std
- Duration of illness 2 to 5 years
- Patients who are on pharmacological treatment as usual
- Cooperative and able to understand Hindi or English

**Exclusion Criteria**

- Patients with a history of co-morbid psychiatric problems.
- Patients with a history of intellectual disability.
- Patients with a history of neurological problems such as epilepsy, head injury etc.
- Patients with a history of substance dependence.
- Patients who has received ECT within last 6 months.
- Those having history of major medical and physical problem.

**Tools to be Used**

- Socio Demographic and Clinical Data Sheet
- Positive and Negative Syndrome Scale [12]
- Cognitive Symptom Checklist [13]
- Digit Symbol Substitution Test [14]
- PGI Memory Scale [15]
- Trail Making Test [16]
- Wisconsin Card Sorting Test [17]

**Research design:** Pre to post comparative research design.

**Training module**

Training package mainly consists cognitive remediation training for 30 sessions in five week, 6 day per week. Cognitive remediation training module adapted from brainwave- R. Brainwave-R is a comprehensive pen-and-paper based cognitive rehabilitation program that is divided into five hierarchically graded modules: Attention, Visual Processing, Memory, Information Processing, and Executive Functions. Although in present study three modules will be taken for cognitive remediation training.

**Attention Remediation Training**

That module will help the patients to remediate their sustain, selective, alternating and divided attention through practice. Speed of information processing is an important aspect of attention, in module addressing each level of attention in increasing patient's speed and processing demands. It involves the techniques like paced random number, word targeting, category targeting, reverse counting, task maintenance, number blocks, decoding, simultaneous tasks, self-evaluation awareness etc.

**Memory Remediation Training**

This module has been designed to teach the patients about memory processes and emphasizes the use of strategies to compensate for memory problems. The memory process involves encoding, organization, maintaining the information in working memory (short term memory), consolidating or storing information into long term memory and retrieval of storage information when needed. In brainwave R module have several technique like learning the stage of memory, types of memory, retrieval, external and internal aids, learning new skills, card matching, functional memory exercises and some other techniques.

**Executive Function Remediation Training**

This module divided into two sections. Part one teaches the patients about executive function and strategies that can be used to compensate for deficits in this area. Part two provides a choice of projects for the patients to organize, plan, and execute using technique that though in part one. It's includes tasks like self-organization, planning, cognitive flexibility, goal setting, self-planning, initiation and regulation some other similar tasks.

Results

**Table-1: Comparison between CRT+ TAU and TAU group at baseline on socio-demographic and clinical variables**

| Variable | | CRT + TAU Mean ± SD, Number (%) | TAU Mean ± SD, Number (%) | F/ $\chi^2$ |
|---|---|---|---|---|
| **Education** | **8th Pass** | 4 (40%) | 4 (40%) | **5.831** |
| | **10th& 12th Pass** | 1 (10%) | 3 (30%) | |
| | **Graduation** | 5 (50%) | 2 (20%) | |
| | **Above Graduation** | 0 (0%) | 1 (10%) | |
| **Marital Status** | **Married** | 5 (50%) | 5 (50%) | **0.301** |
| | **Unmarried** | 5 (50%) | 5 (50%) | |
| **Religion** | **Hindu** | 10 (100%) | 10 (100%) | **2.105** |
| | **Muslim** | 0 (0%) | 0 (0%) | |
| **Residence** | **Urban** | 3 (30%) | 3 (30%) | **1.238** |
| | **Semi Urban** | 2 (20%) | 2 (20%) | |
| | **Rural** | 5 (50%) | 5 (50%) | |
| **Employment Status** | **Employed** | 6 (60%) | 6 (60%) | **0.307** |
| | **Unemployed** | 4 (40%) | 4 (40%) | |
| **Income** | **0-4999** | 3 (30%) | 2 (20%) | **1.895** |
| | **5000-9999** | 6 (60%) | 5 (50%) | |
| | **10000-14999** | 1 (10%) | 3 (30%) | |
| **Family** | **Joint Family** | 7 (70%) | 5 (50% | **2.165** |
| | **Nuclear Family** | 3 (30%) | 5 (50%) | |
| **Age** | | 28.90±2.47 | 29.00±2.21 | **0.710** |
| **Age of Onset** | | 24.50±2.27 | 24.80±2.10 | **0.587** |
| **Total Duration of Illness** | | 4.00±.94 | 4.20±.92 | **0.125** |

***Significant at p<0.05**

**Note:** Indicating No significant different at base level in both the groups in terms of socio demographic variables and clinical variable.

**Table- 2: Comparison between CRT+ TAU group and TAU group on PANSS and Digit Symbol Test scores at base level**

| Variable | Group (Mean ± SD) | | Mean Rank | | Z |
|---|---|---|---|---|---|
| | CRT+ TAU | TAU | CRT+ TAU | TAU | |
| **PANSS Positive** | 23.30±2.21 | 23.60±1.51 | 9.75 | 11.25 | **0.578** |
| **PANSS Negative** | 26.60±1.84 | 26.15±1.67 | 10.55 | 10.44 | **0.039** |
| **PANSS General** | 55.70±2.11 | 54.30±3.92 | 11.75 | 8.25 | **1.745** |
| **PANSS Total** | 105.60±4.27 | 104.40±5.10 | 12.24 | 11.75 | **1.634** |
| **Digit Symbol Test** | 17.90±2.64 | 16.20±1.99 | 12.75 | 8.25 | **0.582** |

***Significant at p<0.05,**Significant at p<0.01**

**Table-3: Comparison between CRT+ TAU group and TAU group on PGI Memory Scale scores at base level**

| Variable | Group (Mean ± SD) | | Mean Rank | | Z |
|---|---|---|---|---|---|
| | CRT+ TAU | TAU | CRT+ TAU | TAU | |
| **PGI Memory Total** | 21.70±1.51 | 21.35±1.34 | 9.95 | 11.05 | **0.425** |
| **Remote Memory** | 00.00±00 | 00.00±00 | 10.50 | 10.50 | **0.000** |
| **Recent Memory** | 00.00±00 | 00.00±00 | 10.50 | 10.50 | **0.000** |
| **Mental Balance** | 2.90±0.32 | 2.90±0.32 | 10.50 | 10.50 | **0.000** |
| **Attention and Concentration** | 2.80±0.42 | 2.76±0.48 | 11.00 | 10.00 | **0.503** |
| **Delayed Recall** | 2.60±0.97 | 2.50±0.97 | 10.95 | 10.05 | **0.449** |
| **Immediate Recall** | 2.90±0.32 | 2.80±0.42 | 11.00 | 10.00 | **0.610** |
| **Verbal Retention for Similar Pairs** | 2.10±1.20 | 2.50±0.97 | 9.45 | 11.55 | **0.906** |
| **Verbal Retention for Dissimilar Pairs** | 2.70±0.48 | 2.80±0.42 | 10.00 | 11.00 | **0.503** |
| **Visual Retention** | 2.40±1.26 | 2.70±0.48 | 10.70 | 10.30 | **0.199** |
| **Recognition** | 3.00±0.00 | 2.80±0.42 | 11.50 | 9.50 | **1.453** |

***Significant at p<0.05,**Significant at p<0.01**

**Table 2 and 3:** Indicating no significant difference in severity of psychopathology, attention and memory at base stage.

**Table-4: Comparison between CRT+ TAU group and TAU group on Trail Making Test and Cognitive Symptoms Check List scores at base level**

| Variable | Group (Mean ± SD) | | Mean Rank | | Z |
|---|---|---|---|---|---|
| | CRT+ TAU | TAU | CRT+ TAU | TAU | |
| **Trail Making Part- A** | 169.80±16.89 | 165.40±18.16 | 11.35 | 9.65 | **0.644** |
| **Trail Making Part- B** | 286.80±34.15 | 266.50±49.39 | 9.65 | 9.00 | **1.330** |
| **CSCL Total** | 166.80±7.60 | 169.90±5.90 | 11.45 | 9.55 | **1.101** |
| **Attention / Concentration** | 34.40±3.37 | 33.60±4.70 | 10.80 | 10.20 | **0.723** |
| **Executive Function** | 57.10±3.84 | 57.20±3.32 | 9.00 | 12.00 | **0.229** |
| **Memory** | 46.90±5.70 | 50.00±7.15 | 10.80 | 10.20 | **1.142** |
| **Visual Processing** | 14.20±1.87 | 13.80±2.85 | 9.20 | 11.80 | **0.229** |
| **Language** | 14.20±3.05 | 15.30±2.95 | 9.05 | 11.95 | **0.997** |

***Significant at p<0.05,**Significant at p<0.01**

**Table4:** Indicating no significant difference in working memory and different neuro-cognitive variables of cognitive symptoms checklist at base level.

**Table-5: Comparison between CRT+ TAU group and TAU group on Wisconsin Card Sorting Test scores at base level**

| Variable | Group (Mean ± SD) | | Mean Rank | | Z |
|---|---|---|---|---|---|
| | CRT+ TAU | TAU | CRT+ TAU | TAU | |
| **Number of trials Administered** | 128.00±00 | 128.00±00 | 10.50 | 10.50 | **0.000** |
| **Total Number of Correct** | 61.20±10.20 | 63.10±12.87 | 9.90 | 11.10 | **0.454** |
| **Total Number of Errors** | 66.80±10.20 | 64.90±12.87 | 11.10 | 9.90 | **0.454** |
| **Percent Errors** | 52.20±7.80 | 50.72±10.00 | 11.20 | 9.80 | **0.532** |
| **Perseverative Responses** | 37.40±14.82 | 39.40±15.48 | 10.15 | 10.85 | **0.265** |
| **Percent Perseverative Responses** | 29.20±11.61 | 30.90±12.02 | 10.05 | 10.95 | **0.341** |
| **Perseverative Errors** | 32.90±11.16 | 36.30±14.41 | 9.70 | 11.30 | **0.607** |
| **Percent Perseverative Errors** | 25.90±8.74 | 28.50±11.29 | 9.80 | 11.20 | **0.532** |
| **Non-perseverative Errors** | 33.90±13.31 | 28.90±11.35 | 11.95 | 9.05 | **1.102** |
| **Percent Non-perseverative Errors** | 29.40±14.52 | 25.00±9.91 | 11.45 | 9.55 | **0.722** |
| **Conceptual Level Responses** | 35.60±13.56 | 37.30±17.19 | 10.25 | 10.75 | **0.189** |
| **Percent Conceptual Level Responses** | 27.10±9.83 | 29.09±13.45 | 9.95 | 11.05 | **0.417** |
| **Number of Categories Completed** | 6.00±0.00 | 1.50±.97 | 10.80 | 10.20 | **0.240** |
| **Trials to Complete First Category** | 12.60±2.11 | 64.30±42.45 | 9.75 | 11.25 | **0.571** |

***Significant at p<0.05,**Significant at p<0.01**

Table 5: Indicating no significant difference in executive function at base level

**Table-6: Comparison between CRT+TAU group and TAU group on PANSS and Digit Symbol Test scores at post intervention phase**

| Variable | Group (Mean ± SD) | | Mean Rank | | Z |
|---|---|---|---|---|---|
| | CRT+TAU | TAU | CRT+TAU | TAU | |
| **PANSS Positive** | 9.80±0.92 | 14.60±1.17 | 5.55 | 15.47 | **3.808**** |
| **PANSS Negative** | 12.50±1.79 | 19.20±1.39 | 5.50 | 15.50 | **3.866**** |
| **PANSS General** | 23.90±1.37 | 38.00±1.63 | 5.50 | 15.50 | **3.803**** |
| **PANSS Total** | 46.20±1.87 | 71.80±2.39 | 5.50 | 15.50 | **3.804**** |
| **Digit Symbol Test** | 56.80±3.36 | 30.80±2.78 | 15.50 | 5.50 | **3.785**** |

***Significant at $p<0.05$, **Significant at $p<0.01$**

Table-6: Shows comparison between CRT+TAU group and TAU group on PANSS and Digit Symbol Test. The table indicating that CRT+TAU group showed statistically significant less positive, negative and general symptoms in comparison to TAU group.

**Table7: Comparison between CRT+TAU group and TAU group on PGI Memory Scale scores at Post intervention phase**

| Variable | Group (Mean ± SD) | | Mean Rank | | Z |
|---|---|---|---|---|---|
| | CRT+TAU | TAU | CRT+TAU | TAU | |
| **PGI Memory Total** | 01.10±1.85 | 18.50±2.27 | 5.50 | 15.50 | **3.868*** |
| **Remote Memory** | 00.00±00 | 00.00±00 | 10.50 | 10.50 | **0.000** |
| **Recent Memory** | 00.00±00 | 00.00±00 | 5.50 | 15.50 | **0.000** |
| **Mental Balance** | 00.00±00 | 2.70±0.48 | 5.50 | 15.50 | **4.147*** |
| **Attention and Concentration** | 00.00±00 | 2.40±0.52 | 5.50 | 15.50 | **4.119*** |
| **Delayed Recall** | 00.00±00 | 2.40±0.52 | 5.50 | 15.50 | **4.119*** |
| **Immediate Recall** | 00.00±00 | 2.30±0.48 | 5.50 | 15.50 | **4.147*** |
| **Verbal Retention for Similar Pairs** | 00.00±00 | 0.40±0.84 | 9.50 | 11.50 | **1.453** |
| **Verbal Retention for Dissimilar Pairs** | 00.60±1.26 | 2.40±0.52 | 7.50 | 13.90 | **2.733*** |
| **Visual Retention** | 00.00±00 | 2.60±0.52 | 5.50 | 15.50 | **4.119*** |
| **Recognition** | 00.50±1.08 | 2.90±0.32 | 6.10 | 14.90 | **3.691*** |

***Significant at p<0.05, **Significant at p<0.01**

Table-7 shows comparison between CRT+TAU group and TAU group at post intervention phase scores on PGI Memory Scale. The CRT+TAU group showed statistically significant less impairment in comparison to TAU group.

**Table 8: Comparison between CRT+TAU group and TAU group on Trail Making Test and Cognitive Symptoms Cheek List scores at post intervention phase**

| Variable | Group (Mean ± SD) | | Mean Rank | | Z |
|---|---|---|---|---|---|
| | CRT+TAU | TAU | CRT+TAU | TAU | |
| **Trail Making Part- A** | 30.50±4.38 | 69.90±10.47 | 5.50 | 15.50 | **3.782**** |
| **Trail Making Part- B** | 48.10±4.95 | 163.10±35.07 | 5.50 | 15.50 | **3.784**** |
| **CSCL Total** | 25.70±2.98 | 91.50±5.08 | 5.50 | 15.50 | **3.791**** |
| **Attention / Concentration** | 08.60±0.84 | 23.80±2.34 | 5.50 | 15.50 | **3.819**** |
| **Executive Function** | 08.30±1.77 | 28.10±2.28 | 5.50 | 15.50 | **3.808**** |
| **Memory** | 04.30±0.67 | 21.80±2.29 | 5.50 | 15.50 | **3.836**** |
| **Visual Processing** | 02.70±1.25 | 9.80±1.62 | 5.50 | 15.50 | **3.810**** |
| **Language** | 01.70±1.34 | 8.00±0.94 | 5.50 | 15.50 | **3.845**** |

***Significant at p<0.05, **Significant at p<0.01**

Table- 8 shows comparison between CRT+TAU group and TAU group at post intervention phase scores on Trail Making Test and Cognitive Symptoms Cheek List. The CRT+TAU group showed grater improvement in cognitive symptoms in comparison to TAU group at post intervention phase.

**Table 9: Comparison between CRT+TAU group and TAU group on Wisconsin Card Sorting Test scores at post intervention phase**

***Significant at p<0.05, **Significant at p<0.01**

| Variable | Group (Mean ± SD) | | Mean Rank | | Z |
|---|---|---|---|---|---|
| | CRT+TAU | TAU | CRT+TAU | TAU | |
| **Number of trials Administered** | 116.10±8.71 | 128.00±0.00 | 6.50 | 14.50 | **3.413**** |
| **Total Number of Correct** | 82.10±8.39 | 76.00±13.17 | 11.80 | 9.20 | **0.984** |
| **Total Number of Errors** | 33.50±9.07 | 52.00±13.17 | 6.75 | 14.25 | **2.841**** |
| **Percent Errors** | 28.49±7.06 | 40.89±10.38 | 7.35 | 13.85 | **2.384**** |
| **Perseverative Responses** | 19.90±9.18 | 35.70±14.17 | 7.05 | 13.95 | **2.611**** |
| **Percent Perseverative Responses** | 16.68±7.15 | 28.00±11.15 | 7.15 | 13.85 | **2.536**** |
| **Perseverative Errors** | 19.50±8.07 | 31.10±12.87 | 7.80 | 13.20 | **2.041**** |
| **Percent Perseverative Errors** | 16.16±6.32 | 24.49±9.91 | 7.75 | 13.25 | **2.082**** |
| **Non-perseverative Errors** | 16.10±60.5 | 19.90±7.05 | 9.10 | 11.90 | **1.062** |
| **Percent Non-perseverative Errors** | 13.65±5.57 | 15.79±5.38 | 9.65 | 11.35 | **0.645** |
| **Conceptual Level Responses** | 74.60±11.30 | 58.80±15.02 | 13.40 | 7.60 | **2.193**** |
| **Percent Conceptual Level Responses** | 62.17±6.89 | 46.00±11.81 | 14.55 | 6.45 | **3.066**** |
| **Number of Categories Completed** | 5.50±0.53 | 3.50±0.85 | 15.50 | 5.50 | **3.926**** |
| **Trials to Complete First Category** | 16.20±6.48 | 23.10±13.64 | 8.80 | 12.20 | **1.289** |

Table-9 shows comparison between CRT+TAU group and TAU group at post intervention phase scores on Wisconsin Card Sorting Test. The CRT+TAU group showed improvement in cognitive flexibility, planning and Thinking in comparison to TAU group at post intervention phase.

## Discussion

The present study examined the effectiveness of **Cognitive Remediation Therapy combined with Treatment as Usual** (**CRT+TAU**) in comparison to **Treatment as Usual** (**TAU**) alone on psychopathology, neuro-cognitive functioning, memory processes, executive functioning, and subjective cognitive symptoms in individuals with schizophrenia at the post-intervention phase. The findings consistently indicate that participants receiving CRT+TAU demonstrated significantly greater improvement across most clinical and cognitive domains, supporting the effectiveness of CRT as an adjunctive intervention.

With respect to **clinical symptomatology**, the CRT+TAU group exhibited significantly lower scores on **PANSS Positive, Negative, General Psychopathology, and Total scores** compared to the TAU group. These findings suggest that CRT contributes to a broad reduction in symptom severity. While antipsychotic medication primarily targets positive symptoms, improvements across all PANSS domains indicate that CRT may indirectly influence symptom expression by enhancing attention, executive control, and information processing abilities[7, 18]. The significant reduction observed in **negative symptoms** is particularly important, as negative symptoms are typically resistant to pharmacological treatment and are strongly associated with poor functional outcomes [19].

In relation to **processing speed and attention**, participants in the CRT+TAU group showed significantly superior performance on the **Digit Symbol Test** and **Trail Making Test Parts A and B**. These tests assess psychomotor speed, visual scanning, sustained attention, and cognitive flexibility. Processing speed deficits are considered a core cognitive impairment in schizophrenia and are closely linked to functional disability[1, 20]. The observed improvements therefore highlight the clinical relevance of CRT in addressing foundational cognitive deficits.

The findings on the **PGI Memory Scale** further demonstrate the beneficial effects of CRT on memory functioning. Participants in the CRT+TAU group showed significant improvement in **overall memory performance**, as well as in **mental balance, attention and concentration, immediate recall, delayed recall, visual retention, recognition, and verbal retention for dissimilar pairs**. These domains rely heavily on active encoding, attention regulation, and retrieval strategies, which are directly, targeted through structured cognitive remediation exercises[1, 21, 22]. In contrast, **remote memory, recent memory, and verbal retention for similar pairs** did not show significant improvement, suggesting that these domains may be relatively stable or require longer or more intensive intervention to demonstrate change[21, 22].

Significant improvements in **executive functioning** were further evidenced by performance on the **Wisconsin Card Sorting Test (WCST)**. The CRT+TAU group demonstrated significantly fewer total and perseverative errors, lower percentages of perseverative responses, higher conceptual level responses, and a greater number of categories completed. These findings indicate enhanced cognitive flexibility, abstract reasoning, set-shifting, and problem-solving abilities—executive functions commonly impaired in schizophrenia[20, 23]. The reduction in perseverative responding is particularly meaningful, as perseveration is a hallmark of frontal-lobe dysfunction in schizophrenia [18].

In addition to objective cognitive improvements, participants receiving CRT+TAU reported significantly lower scores on the **Cognitive Symptoms Checklist (CSCL)** total and all subdomains, including **attention/concentration, executive function, memory, visual processing, and language**. Reduced subjective cognitive complaints suggest that CRT improves not only cognitive performance but also patients' awareness and perception of their cognitive functioning. Subjective cognitive symptoms are known to influence treatment engagement, insight, and quality of life [20, 7].

Taken together, the convergence of improvements across **psychopathology, processing speed, memory, executive functioning, and subjective cognitive experience** strongly supports the cognitive model of schizophrenia, which emphasizes the central role of neurocognitive deficits in symptom expression and functional impairment [20]. The findings indicate that CRT acts synergistically with standard treatment to produce meaningful cognitive and clinical benefits.

In conclusion, the present study provides strong empirical support for the integration of **Cognitive Remediation Therapy** into routine treatment programs for individuals with schizophrenia. CRT appears to be particularly effective in improving modifiable cognitive domains and reducing symptom severity when used as an adjunct to pharmacological treatment. These findings underscore the importance of comprehensive, recovery-oriented treatment approaches that address both cognitive deficits and clinical symptoms[7,18].

### Clinical Implications

The findings highlight the importance of incorporating **Cognitive Remediation Therapy** into routine treatment programs for individuals with schizophrenia. CRT appears to be particularly beneficial in addressing cognitive deficits that are not adequately managed by pharmacotherapy alone. Improvements in attention, memory, and processing speed may facilitate better treatment adherence, psychosocial

functioning, and overall quality of life. The results support the use of CRT as part of a **comprehensive, recovery-oriented intervention model** in clinical and rehabilitation settings.

**Limitations**

Despite the encouraging findings, certain limitations should be acknowledged. The sample size was relatively small, which may limit the generalizability of the results. The post-intervention assessment did not include long-term follow-up, making it difficult to determine the durability of treatment gains. Additionally, functional outcomes such as social or occupational functioning were not directly assessed, which could have provided further insight into the real-world impact of cognitive improvements.

**Future Directions**

Future research should employ larger samples and longitudinal designs to examine the long-term sustainability of CRT-related gains. Incorporating functional outcome measures and neurobiological markers may help clarify the mechanisms through which cognitive remediation influences symptom reduction. Further studies may also explore the differential effects of specific CRT components and the optimal duration and intensity of intervention for targeting resistant cognitive domains.

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